

Application Number 10/823,483  
Amendment dated August 14, 2007  
Response to Advisory Action mailed July 19, 2007

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Remarks/Arguments

Huffman teaches that electrodes cannot be mechanically spaced closer than 100,000

The OBJECTIVE of the Huffman paper seems to be (page 573, fourth paragraph):

"to provide a novel means of converting heat-to-electricity ... In brief, the technical approach is to formulate cesium graphite-intercalation-compounds (GICs)".

and the RATIONALE appears to be (page 573, last sentence):

"Accordingly, the TTC uses intercalating atoms to reduce the graphite (which should be more effective than alloying techniques used in thermoelectrics) while electron transport is maintained by quantum mechanical tunneling without the arc drop penalty associated with thermionics."

On page 574, first paragraph, Huffman goes on to give a sketch and description of his hypothetical device, in which the separation of the electrodes is a supposed 10 . Applicant uses the words "hypothetical" and "supposed", because under the section entitled TECHNICAL APPROACH (page 574, fourth paragraph) Huffman's states:

"Attempts to mechanically space electrodes at Thermo Electron at distances less than 0.001cm have proven unsuccessful."

Huffman therefore very clearly teaches that it is not possible to mechanically space electrodes closer than 100,000 .

For a *prima facie* case of obviousness to be made, there has to be a reasonable expectation of success, and here Huffman clearly indicates that a 10 is not possible . Examiner has not explained how there would be a reasonable expectation of success given Huffman's very clear disclosure, and therefore a sufficiently robust case for the combination of the prior art of Shakouri and Fitzpatrick with Huffman has not been made.

Examiner must weigh the power of each reference to suggest solutions to one of ordinary skill in the art, considering the degree to which one reference might accurately discredit another.

Applicant believes that Huffman discredits his own teaching, and therefore Examiner has not

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made a *prima facie* case for the combination of the prior art of Shakouri and Fitzpatrick with Huffman.

**Huffman does not teach electrodes mechanically spaced at 10**

Under the section entitled TECHNICAL APPROACH (page 574, fourth paragraph) Huffman further states:

“However, experiments with graphite intercalation compounds have demonstrated that it is possible to chemically space graphite layers to the dimensions required for the TTC (i.e., order of 10 ) with a number of substances.”

So what are the physical features of the device Huffman actually reduces to practice and fabricates?

In the section entitled EXPERIMENTAL DESIGN OF TEST DEVICE on page 578, second paragraph, Huffman discloses:

“The TTC test device uses a modification of a planar, variable-spaced thermionic converter ... A 6-mm-thick disk of ZYH HOPG is brazed to the tungsten hot and cold junctions.”

In the section entitled EXPERIMENTAL RESULTS on page 578, SEVENTH paragraph, Huffman discloses:

“At the TTC startup, the HOPG height almost doubled over a two hour intercalation period.”

In other words, the physical separation of the two electrodes in the operational device disclosed by Huffman is some 12mm, not 10 . The 10 is typical of the distance between the planes of graphite in the cesium-intercalated HOPG material.

Combination of the prior art of Shakouri and Fitzpatrick with Huffman would lead to a device in which a distance of around 12mm separated the electrodes and the space between the electrodes would be filled with cesium-intercalated HOPG material. Such a combination does not show every element of the claims pending in the present application, and therefore Examiner has not made a *prima facie* case for the combination of the prior art of Shakouri and Fitzpatrick with Huffman.

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**Huffman does not teach an increase in performance of a thermotunnel converter in which the electrode spacing is of the order of 10 Angstroms**

Huffman hypothesizes in the first paragraph on page 574 that:

"To this extent, the TTC is similar to a thermionic converter except that the emitter-collector spacings of the TTC are of the order of 10 Angstroms compared to typical thermionic converter spacings of 0.25 mm. This quantitative reduction in spacing results in a fundamental qualitative difference in the operation of the device."

As mentioned above, Huffman goes on to make it clear that such a mechanical spacing is impossible; in fact, attempts to achieve mechanical spacing to a distance closer than 100,000 "have proven unsuccessful". The main subject of the paper is an investigation of a chemical spacing of 10 .

The main finding of the paper is that a reduction in spacing does not in fact lead to a fundamental quantitative difference in the performance of the experimental device. Thus, in Figure 8, Huffman has shown a Figure of Merit performance curve based on extrapolations, which show that at 900K (the operating temperature of his experimental device), the Figure of Merit is about  $10^{-2}$ . This is about an order of magnitude better than conventional thermoelectric devices, and would constitute a fundamental difference in the performance of his proposed device.

However, the experimental data were some 200-fold lower than expected (see the DISCUSSION section); in other words the Figure of Merit was more like  $5 \times 10^{-5}$ , which is more than an order of magnitude lower than conventional thermoelectric devices.

Thus the teaching of Huffman's experimental investigation is that there is not a quantitative increase, but instead a decrease, in the performance of the device having electrodes separated by 10 angstroms.

For a prima facie case of obviousness to be made, there has to be a reasonable expectation of success.

Examiner must weigh the power of each reference to suggest solutions to one of ordinary skill in the art, considering the degree to which one reference might accurately discredit another.

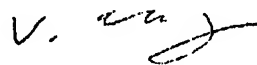
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Applicant therefore believes that Huffman discredits his own teaching, and therefore Examiner has not made a *prima facie* case for the combination of the prior art of Shakouri and Fitzpatrick with Huffman.

Applicant respectfully submits that this application is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing the application with the Applicant over the telephone might advance prosecution, Applicant would welcome the opportunity to do so.

Applicant is making this reply within three months of the mailing date of the final action, which was May 15, 2007, and any extension fees required to be paid pursuant to 37 CFR 1.136(a) are therefore not necessary.

Respectfully submitted,



Avto TAVKHELIDZE  
Inventor